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Drought in Regional Climate Model simulations, influence of the RCM and the LSM on the resulting meteorological and soil moisture drought

Anaïs Barella-Ortiz and Pere Quintana-Seguí
Observatori de l'Ebre (Universitat Ramon Llull - CSIC), Roquetes, Spain (pquintana@obsebre.es)

Drought is the result of the interaction of atmospheric and continental surface processes, together with water resources management. Its impacts are diverse and serious, ranging from environmental to socioeconomical issues. Drought has been seen to increase with a warmer climate, becoming more frequent, severe and lasting. Therefore, it is vital to understand the different processes involved in it and how these are reproduced by our current modeling tools, in order to be able to perform a better diagnosis, monitoring and prediction, as well as more suitable management plans.

The work herein presented analyzes how Regional Climate Models (RCMs) represent drought. First, we focus on meteorological drought. Since it is mainly driven by a shortage of precipitation, we compare this variable as given by the forcing dataset (ERA-Interim) and different RCMs. In a second step, a comparison between the soil moisture from RCMs and offline LSMs, allows us to address modeling issues regarding soil moisture droughts. These analyses are carried out by means of the calculation of statistics using standardized indices which we have developed for precipitation (SPI) and soil moisture (SSMI). They provide information on how RCMs modify drought and whether they improve its representation, compared to the driving dataset. The RCMs used correspond to simulations from the Med-CORDEX database: RCSM4, CCLM4, and PROMES models, which are forced with ERA-Interim. The offline LSM simulations, taken as the reference drought, belong to ORCHIDEE and SURFEX LSMs forced by MSWEP. In addition, we have also included a simulation from the SURFEX LSM forced by SAFRAN, which is more accurate than MSWEP, and has higher resolution. All of the simulations are selected for the Iberian Peninsula, which is a region known to be affected by drought, and range from 1989 to 2009.

Results show that although RCMs reproduce the main drought events, there are aspects, like their duration or extension that differ between them. Forcing biases are seen to be a source of uncertainty, but also model formulation. For instance, it affects the temporal scale at which precipitation variability affects soil moisture variability and thus, the way drought is represented.